

REMARKS

Applicants respectfully request entry of this Amendment and consideration of this application, as amended.

The present application claims a method for removing bromine-reactive contaminants from an aromatic hydrocarbon stream which uses an *unbound or self-bound* acid active catalyst composition to remove mono-olefin bromine-reactive contaminants from aromatic hydrocarbon feedstreams of negligible diene level.

Claims 36-38 have been amended to depend from claim 21, rather than from canceled claim 1. The specification has been amended to replace the term BR with BI (relating to Bromine Index, which itself is described at page 2, lines 1-2) in the title and at page 2, line 9. This corrects a preliminary amendment of the specification which was inadvertently made.

Claims 21-40 are presently in the application.

Rejection Under 35 USC 112, Second Paragraph

Claims 21-38 have been rejected under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as their invention. In particular, the Examiner urges that the expression "a negligible level" in line 3 of claims 21 and 31 does not affirmatively recite any level, so that the scope of the claim cannot be ascertained.

This rejection is respectfully traversed.

Applicants respectfully argue that the claims, taken in the context of the definition for "negligible level" provided in the specification at page 4, lines 11-12 are sufficiently clear to particularly point out and distinctly claim the subject matter which applicants regard as their invention. In particular, the specification teaches that "[b]y negligible is meant that the level [of dienes] is below 50 ppm, essentially diene-free or too low to be quantified." It is respectfully submitted that such terminology is sufficient to provide the requisite notice to potential infringers of what is intended by the term "negligible levels of diene." One skilled in the art would interpret such a term to include diene levels sufficiently low enough to permit operation of the invention, i.e., removal of bromine-

reactive contaminants by contacting the feedstream with active catalyst compositions under conditions sufficient to remove mono-olefinic bromine-reactive contaminants. Moreover, the specification teaches specific diene levels (less than 50 ppm) which provide one skilled in the art with reasonable examples of operative levels for the invention. Accordingly, withdrawal of this rejection is respectfully requested.

Rejection under 35 USC 102(b)

The Examiner has rejected claims 21, 29-32, and 36 under 35 USC 102(b) as being anticipated by U.S. Patent No. 3,400,169 to Eng et al. (Eng). Eng is cited as disclosing a process of removing bromine-reactive contaminants from an aromatic hydrocarbon stream comprising benzene, by feeding the hydrocarbon stream into a diolefinic-removing zone to remove substantially all of the diolefins from the hydrocarbon stream to produce a vapor stream which is contacted with, what the Examiner characterizes as, an acid active catalyst in a hydrofiner zone to reduce the bromine number in the aromatic hydrocarbon feed. The hydrofiner is operated at a temperature of from 400 to 700°F, under a pressure of from 500 to 1000 psig, and at a feed rate from about 0.5 to 5 hr⁻¹.

This rejection is respectfully traversed.

Eng does teach a process wherein a steam cracked naphtha and a slurry composed of steam cracked naphtha and a silica alumina catalytic cracking catalyst are contacted under conditions which remove part of the monoolefins and substantially all diolefins (column 2, lines 8-18). However, Eng fails to disclose or suggest treating their diolefin-depleted stream with the "acid active catalyst composition" required by the present claims, opting instead for a "solid catalyst consisting of cobalt oxide and molybdenum oxide either as a mixture or contained as cobalt molybdate on a solid absorbent carrier which may be absorbent alumina, bauxite or any of a variety of well-known carriers employed for this general purpose" (column 3, lines 24-28). The present specification teaches traditional base metal-containing hydrogenation or hydrotreating catalysts such as CoMo/Al₂O₃ for use in the pre-treating step for removing diolefins in the absence of

hydrogen (page 5, lines 7-10), but only teaches (and claims) acidic catalysts for the monoolefins removal step of the broad claims of the invention.

Given this difference between the reference and the present claims, it is respectfully submitted that Eng neither discloses nor suggests to one skilled in the art the present invention's treatment of feeds having negligible diene levels with the acid active catalyst composition required by the present claims. In view of this, withdrawal of this rejection is respectfully requested.

Rejections under 35 USC 103(a)

The Examiner has rejected claims 22-24 under 35 USC 103(a) as being obvious over U.S. Patent No. 3,400,169 to Eng et al. The Examiner acknowledges that Eng fails to disclose feed with diene levels below 50 ppm. However, inasmuch as Eng teaches "substantially all of the diolefins are removed from the feedstream," the Examiner urges it would have been obvious to modify Eng's process by using a feedstream having less than 50 ppm of diene inasmuch as "Eng desires to use a feedstream that contains no dienes." Moreover, despite Eng's failure to disclose treating aromatic hydrocarbon streams comprising C₇₊ reformat or light reformat, the Examiner argues it would have been obvious to modify Eng's process by using such aromatic hydrocarbon streams given that "Eng discloses that the feedstream contains a high percentage of benzene and other aromatics" and to expect the same or similar results.

This rejection is respectfully traversed.

As previously argued, Eng et al. do teach a process wherein a steam cracked naphtha and a slurry composed of steam cracked naphtha and a silica alumina catalytic cracking catalyst are contacted under conditions which remove part of the monoolefins and substantially all diolefins (column 2, lines 8-18). However, Eng et al. fail to disclose or suggest treating their diolefin-depleted stream with the "acid active catalyst composition" required by the present claims, opting instead for a "solid catalyst consisting of cobalt oxide and molybdenum oxide either as a mixture or contained as cobalt molybdate on a solid absorbent carrier which may be absorbent alumina, bauxite or any of a variety of well-known carriers employed for this general purpose" (column 3,

lines 24-28). The present specification teaches traditional base metal-containing hydrogenation or hydrotreating catalysts such as CoMo/Al₂O₃ for use in the pre-treating step for removing diolefins in the absence of hydrogen (page 5, lines 7-10), but only teaches (and claims) acidic catalysts for the mono-olefins removal step of the broad claims of the invention.

Given this difference between the reference and the present claims, it is respectfully submitted that the reference neither discloses nor suggests to one skilled in the art the present invention's treatment of feeds having negligible diene levels with the acid active catalyst composition required by the present claims. In view of this, withdrawal of this rejection is respectfully requested.

The Examiner has rejected claims 25-28, 36, 37 and 39 under 35 USC 103(a) as being unpatentable over U.S. Patent No. 3,400,169 to Eng et al. in view of U.S. Patent No. 5,296,428 to Degnan et al. (Degnan). The Examiner cites Eng et al. as above and further notes that it "does not disclose the physical characteristics of the hydrofiner catalyst." Thus the Examiner relies upon Degnan as disclosing a catalyst comprising MCM-36 having the "pore/channel system having ten or more membered oxygen ring openings" and a hydrogenation or dehydrogenation component. The Examiner concludes it would have been obvious to modify Eng's process by using Degnan's catalyst in the Eng hydrofiner zone because Degnan's catalyst is effective in a hydrogenation or dehydrogenation process.

This rejection is respectfully traversed.

As previously argued, Eng et al. do teach a process wherein a steam cracked naphtha and a slurry composed of steam cracked naphtha and a silica alumina catalytic cracking catalyst are contacted under conditions which remove part of the monoolefins and substantially all diolefins (column 2, lines 8-18). However, Eng et al. fail to disclose or suggest treating their diolefin-depleted stream with the "acid active catalyst composition" required by the present claims, opting instead for a "solid catalyst consisting of cobalt oxide and molybdenum oxide either as a mixture or contained as cobalt molybdate on a solid absorbent carrier which may be absorbent alumina, bauxite or any of a variety of well-known carriers employed for this general purpose" (column 3,

lines 24-28). The present specification teaches traditional base metal-containing hydrogenation or hydrotreating catalysts such as CoMo/Al₂O₃ for use in the pre-treating step for removing diolefins in the absence of hydrogen (page 5, lines 7-10), but only teaches (and claims) acidic catalysts for the mono-olefins removal step of the broad claims of the invention. Moreover, the present specification and claims appear silent regarding the presence or absence of a hydrogenation/dehydrogenation component for the acid active catalyst composition used for removing mono-olefinic bromine-reactive contaminants in the present application. Accordingly, the likelihood of one skilled in the art selecting Degnan for combination with Eng on this basis is minimal at best. Moreover, even such combination would nonetheless fail to disclose or suggest the present invention, given Eng's shortcomings as pointed out above. In view of this, withdrawal of this rejection is respectfully requested.

The Examiner has rejected claims 33-35 under 35 USC 103(a) as being unpatentable over U.S. Patent No. 3,400,169 to Eng et al. in view of U.S. Patent No. 4,089,798 to Sugiyama et al. (Sugiyama). The Examiner cites Eng as above and further notes that it "does not disclose the claimed diene-removing catalyst." Thus the Examiner relies upon Sugiyama as "disclosing a catalytic cracking process by using a catalyst comprising Ni, Mo, and alumina." The Examiner argues it would have been obvious to modify Eng's process by using Sugiyama's catalyst because "Eng discloses that a cracking catalyst can be used in the diene-removing zone" and concludes one skilled in the art would use the Sugiyama catalyst in the Eng process because the Sugiyama catalyst and the Eng catalyst have an equivalent function.

This rejection is respectfully traversed.

As previously argued, Eng et al. do teach a process wherein a steam cracked naphtha and a slurry composed of steam cracked naphtha and a silica alumina catalytic cracking catalyst are contacted under conditions which remove part of the monoolefins and substantially all diolefins (column 2, lines 8-18). However, Eng et al. fail to disclose or suggest treating their diolefin-depleted stream with the "acid active catalyst composition" required by the present claims, opting instead for a "solid catalyst consisting of cobalt xide and molybdenum oxide either as a mixture or contained as

cobalt molybdate on a solid absorbent carrier which may be absorbent alumina, bauxite or any of a variety of well-known carriers employed for this general purpose" (column 3, lines 24-28). The present specification teaches traditional base metal-containing hydrogenation or hydrotreating catalysts such as $\text{CoMo}/\text{Al}_2\text{O}_3$ for use in the pre-treating step for removing diolefins in the absence of hydrogen (page 5, lines 7-10), but only teaches (and claims) acidic catalysts for the mono-olefins removal step of the broad claims of the invention. Accordingly, even if it were assumed, arguendo, that one skilled in the art would be led to substitute Sugiyama's catalyst for diolefin-removing step of the present invention, such a combination would nonetheless fail to disclose or suggest the present invention, given Eng's shortcomings as pointed out above. In view of this, withdrawal of this rejection is respectfully requested.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

CONCLUSION

Applicants respectfully submit that the present claims describe a new, useful and unobvious method for decreasing bromine-reactive contaminants in aromatic streams with an unbound or self-bound acid active catalyst. Accordingly, it is respectfully requested that the Examiner enter and allow the presently amended claims.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE**In the specification:**

The TITLE at lines 5 and 6 of page 1, has been amended as follows:

DECREASING [BR] BI-REACTIVE CONTAMINANTS
IN AROMATIC STREAMS

Paragraph beginning at line 1 of page 2 has been amended as follows:

Undesirable hydrocarbon contaminants containing olefinic bonds are quantified by the Bromine Index (BI). Undesirable olefins, including both dienes and mono-olefins, have typically been concurrently removed from aromatic streams such as BTX by contacting the aromatic stream with acid-treated clay. Other materials, e.g., zeolites, have also been used for this purpose. Clay is an amorphous naturally-occurring material, while zeolites used for this purpose generally are synthesized and are therefore more expensive. Both clay and zeolites have very limited lifetimes in aromatics treatment services. The length of service correlates with the level of bromine reactive impurities in the feedstream. [BR]BI-reactive contaminants rapidly age both clay and zeolites. Indeed, although clay is the less expensive of the two alternatives, large aromatic plants can spend more than a million dollars a year on clay. Furthermore, since zeolites are considerably more expensive than clay, their use in removing hydrocarbon contaminants can only be justified by dramatically improved stability in aromatics treatment so that their cycle length is practical.

In the claims:

Claims 36, 37 and 38 have been amended as follows:

36. (Amended) The method of claim 21 [1] wherein said catalyst is unbound.
37. (Amended) The method of claim 21 [1] wherein said catalyst is self-bound.
38. (Amended) The method of claim 21 [1] wherein said catalyst comprises self-bound MCM-22.